Fuzzy whole hypersoft set and their application in frequency matrix multi attribute decision making technique (MADMT)

Cite as: AIP Conference Proceedings **2282**, 020010 (2020); https://doi.org/10.1063/5.0028274
Published Online: 20 October 2020

M. Sagaya Bavia, D. Nagarajan, M. Lathamaheswari, and J. Kavikumar

Fuzzy Whole Hypersoft Set and their Application in Frequency Matrix Multi Attribute Decision Making Technique (MADMT)

M. Sagaya Bavia[1,a)] D. Nagarajan[2,b)] M. Lathamaheswari[3,c)] J.Kavikumar [4,d)]

[1,2,3] Department of Mathematics,Hindustan Institute of Technology & Science,Chennai-603103.India

[4]Department of Mathematics and Statistics, Faculty of Applied Science and Technology, Universiti Tun Hussein Onn Malaysia, Malaysia

[a)]msbavia0190@gmail.com,[b)]dnrmsu2002@yahoo.com,[c)]lathamax@gmail.com,[d)]kavi@uthm.edu.my

Abstract. Decision making techniques is the aim for finding a good alternative. Much of its in the real life application in the surrounding. The Fuzzy whole hyper soft set and Frequency Matrix Multi Attributes Decision Making Scheme (FMMADMS) is one of most important method to find the decision making process. In this paper explained hyper soft and included one diligence in which brand paint is best for submarine painting. This method is useful to conclude the decision making process.

INTRODUCTION

The Fuzzy set theory introduced 1965. It is represented by membership. Introduced Intuitionistic fuzzy set [1] and [2]. An approach of TOPSIS technique for developing supplier selection with group decision making under type-2 neutrosophic number [3],[4],[5], membership of hesitation should be one. [6],[7],[8],[9] and [10].The degree of hesitation , Multi-criteria decision aid for the formulation of sustainable technological energy priorities using linguistic variables [11],[12,[13] and [14]. Introduced Neutrosophic Probability Set and Logic [15]. Discussed On Multi-Criteria Decision Making problem via Bipolar Single-Valued Neutrosophic Settings[16],[17] , by considering neutrality and opposite [18],[19],[20]. Discourse an Integrated Neutrosophic-TOPSIS Approach and Its Application to Personnel Selection: A New Trend in Brain Processing and Analysis et [21],[22],[23]. Introduced From soft set to information systems [24].In Fuzzy type 2 traffic application in [25].Effective analysis in [26]. Type 2 application in biomedical [27],[28].In [29] image extraction [30] application in control system.. In [31] and [32] application in interval type 2 in block chain and Dompi interval.

FUNDAMENTAL

In this section, some of the fundamentals of hyper soft are given for better understanding of the work.

Hypersoft Set

The initial discourse for universe P_o(M) the power set of M and $b_1,b_2,\ldots b_n$for n greater than are equal to one in the attributes set $B_1,B_2,\ldots B_n$with $B_i \cap B_J = \varphi$

For i is not equal to j and $i, j \in \{1,2,3,\ldots n\}$. The ordered pair is $(Function, B_1, \times B_2 \times \ldots . \times B_n)$ where, $Function: B_1 \times B_2 \times \ldots . \times B_n \rightarrow P_o(M)$ is hypersoft M.

Here we provide the proposed algorithm for the decision making process for set numbers under fuzzy set

Fourth National Conference on Recent Trends in Mathematics & Its Applications
AIP Conf. Proc. 2282, 020010-1–020010-7; https://doi.org/10.1063/5.0028274
Published by AIP Publishing. 978-0-7354-4012-8/$30.00

environment. And it is described as below.
Step 1. Decision of universe.
Step 2. Defining attributes and mapping.
Step 3. Matrix representation.
Step 4. Introduced operators.
Step 5: ranking using matrix .
Step 6. Final rank allotted :
Step 7. validate.

APPLICATION OF THE PROPOSED ALGORITHM TO FIND THE BEST PAINT

In this section, the best paint for submarine painting has been analyzed among the different paints using fuzzy whole hypersoft fuzzy numbers. The procedure is described by the following steps.

STEP 1: decision of universe

Let U={b1,b2,b3} three brands of paint. T is the subset of U

STEP 2: mapping

Let attributes be $A_j^k, j = 1,2...5, k = 1,2,3$

A_1^k=cost

A_2^k=corrosiveresistance

A_3^k=durability

A_4^k=availability

A_5^k=toxicity

The importance weight of the criteria in Table:1

TABLE 1. Attributes

attributes	D_1	D_2	D_3
cost	H	VH	VH
corrosiveresista	H	H	H
durability	MH	H	MH
availability	MH	MH	MH
toxicity	H	H	H

The rating of the three brands by three decision makers under all attributes are given below in Table 2. The attributes and brands and its related decision maker.

TABLE 2. Attributes, Brand and its Decision Makers

Attributes	**Brands**	D1	D2	D3
A_1^k=cost				
	B_1	6	8	7
	B_2	3	4	4
	B_3	4	5	6
A_2^k=corrosivere				
	B_1	6.3	8	9
	B_2	9	10	10
	B_3	7	9	10
A_3^k=durability				
	B_1	5.7	7.7	9
	B_2	7	9	10
	B_3	7	9	10
A_4^k=availability				
	B_1	7.7	9.3	10
	B_2	7	9	10
	B_3	8.3	9.7	10
A_5^k=toxicity				
	B_1	3	5	7
	B_2	5.7	7.7	9
	B_3	7	9	10

STEP3: matrix representation

$$C_{ij}^{\alpha 1} = \begin{bmatrix} 6 & 6.3 & 5.7 & 7.7 & 3 \\ 3 & 9 & 7 & 7 & 5.7 \\ 4 & 7 & 7 & 8.3 & 7 \end{bmatrix}$$

$$C_{ij}^{\alpha 2} = \begin{bmatrix} 8 & 8 & 7.7 & 9.3 & 5 \\ 4 & 10 & 9 & 9 & 7.7 \\ 5 & 9 & 9 & 9.7 & 9 \end{bmatrix}$$

$$C_{ij}^{\alpha 3} = \begin{bmatrix} 7 & 9 & 9 & 10 & 7 \\ 4 & 10 & 10 & 10 & 9 \\ 6 & 10 & 10 & 10 & 10 \end{bmatrix}$$

Here $C_{ij}^{\alpha_k}$,k=1,2,3 represented attributes by rows and columns .

STEP 4: construction of local operator and global whole memberships for FHSS

$$\Omega^{1}_{\alpha 1}(B_1) = (\max \mu^{A1}_{j}(b1)) = 7.7$$

$$\Omega^{1}_{\alpha 1}(B_2) = (\max \mu^{A1}_{j}(b2)) = 9$$

$$\Omega^{1}_{\alpha 1}(B_3) = (2\max \mu^{A1}_{j}(b3) = 8.3$$

$$\Omega^{2}_{\alpha 1}(B_1) = (\min \mu^{A1}_{j}(b1)) = 3$$

$$\Omega^{2}_{\alpha 1}(B_2) = (\min \mu^{A1}_{j}(b2)) = 3$$

$$\Omega^{2}_{\alpha 3}(B_3) = (\min \mu^{A1}_{j}(b3) = 4$$

$$\Omega^{3}_{\alpha 1}(B_1) = (\neg(\mu^{A1}_{j}(b1)) = 5.74$$

$$\Omega^{3}_{\alpha 1}(B_2) = (\neg(\mu^{A1}_{j}(b2)) = 6.34$$

$$\Omega^{3}_{\alpha 3}(B_3) = (\neg(\mu^{A1}_{j}(b3) = 6.66$$

STEP 5:

$$C^{\alpha 1}_{ij} = \begin{bmatrix} 6 & 6.3 & 5.7 & 7.7 & 3 & 7.7 \\ 3 & 9 & 7 & 7 & 5.7 & 9 \\ 4 & 7 & 7 & 8.3 & 7 & 8.3 \end{bmatrix}$$

coloumn b3=8.3

t=1, position 1(P_1) for b2,P_2 for b2 ,P_3 for b1

$$C^{\alpha 2}_{ij} = \begin{bmatrix} 6 & 6.3 & 5.7 & 7.7 & 3 & 3 \\ 3 & 9 & 7 & 7 & 5.7 & 3 \\ 4 & 7 & 7 & 8.3 & 7 & 4 \end{bmatrix}$$

b3=7.4

t=2, position 1(P1) for b1 and b2

$$C^{\alpha 3}_{ij} = \begin{bmatrix} 6 & 6.3 & 5.7 & 7.7 & 3 & 5.74 \\ 3 & 9 & 7 & 7 & 5.7 & 6.34 \\ 4 & 7 & 7 & 8.3 & 7 & 6.66 \end{bmatrix}$$

b3=6.66

t=3, position 1(P_1) for b3,P_2 for b2 P_3 for b1

STEP6: construction of frequency matrix $F_{qp}$for final ranking

$$F^{\alpha_1}_{pq} = \begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 0 \\ 2 & 1 & 0 \end{bmatrix}$$

Step 7:

Percentage authenticity of first position for b3=(2/3)*100=66.67%

Percentage authenticity of second position for b2=(2/4)*100=50%

Percentage authenticity of third position for b1=(2/2)*100=100%

Similarly we can calculate for other 2 decision makers so that we define the frequency matrix as follow

$$F_{pq}^{\alpha_2} = \begin{bmatrix} 1 & 0 & 2 \\ 1 & 2 & 0 \\ 2 & 1 & 1 \end{bmatrix}, F_{pq}^{\alpha_3} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 3 & 0 & 0 \end{bmatrix},$$

For $F_{pq}^{\alpha_2}$

Percentage authenticity of first position for b3=(2/4)*100=50%
Percentage authenticity of second position for b2=(2/3)*100=66.67%
Percentage authenticity of third position for b1=(2/3)*100=66.67%

For $F_{pq}^{\alpha_3}$

Percentage authenticity of first position for b3=(3/5)*100=60%
Percentage authenticity of second position for b2=(1/2)*100=50%
Percentage authenticity of third position for b1=(1/2)*100=%

We get brand b2 is better than the other two brands of paints.

CONCLUSION

As a result of the behaviour to allotted the ranking with decision.In FWHSSsame attribute for same time.With percentage measure to guarantee the accuracy of the scheme. It shows that the decision is unbiased .The above result reveals that the brand b2 is better than other two brand of paint for submarine painting. In future new operator use for this application.

ACKNOWLEDGEMENT

This research was supported by the Universiti Tun Hussein Onn Malaysia, Malaysia, under FRGS Grant N0:K179.

REFERENCES

1. K.T. Atanassov, Intuitionistic fuzzy set. Fuzzy set and Systems, 20(1), 87-96 (1986)
2. A.M. Basset, M. Saleh, A. Gamal and F. Smarandache, (2019). An approach of TOPSIS technique for developing supplier selection with group decision making under type-2 neutrosophic number. Applied Soft Computing, 77, 438-452 (2019).
3. A.M. Basset, V. Chang, A. Gamal, A and F. Smarandache, An integrated neutrosophic ANP and VIKOR method for achieving sustainable supplier selection: A case study in importing field. Computers in Industry, 106, 94-110 (2019).
4. A.M. Basset, G. Manogaran, A. Gamal, and F. Smarandache, A group decision making framework based on neutrosophic TOPSIS approach for smart medical device selection. Journal of medical systems, 43(2), 38 (2019).
5. A.M. Basset, V. Chang and A. Gamal, Evaluation of the green supply chain management practices: A novel neutrosophic approach. Computers in Industry, 108, 210-220 (2019).
6. A.M. Basset, G. Manogaran, A. Gamal, and F. Smarandache, A hybrid approach of neutrosophic sets and DEMATEL method for developing supplier selection criteria. Design Automation for Embedded Systems, 1-22.

7. A.M. Basset, A. Atef and F. Smarandache, A hybrid Neutrosophic multiple criteria group decision making approach for project selection. Cognitive Systems Research (2018).
8. S. Ashraf, E. E. Kerre and M. Qayyum, The intuitionistic fuzzy multicriteria decision making based on inclusion degree. ComptesRendus Del' AcademieBulgare Des Sciences, 70(7), 925-934 (2017).
9. N. Cagman, S. Enginoglu and F. Crtak, Fuzzy Soft set Theory and its Applications. Iranian Journal of Fuzzy Systems, 8(3), 137-147 (2011).
10. Y. Deng, F. T. Chan, Y. Wu and D. Wang, A new linguistic MCDM method based on multiple criterion data fusion. Expert Systems with Applications, 38(6), 6985-6993 (2011).
11. H. C. Doukas, B. M. Andreas and J. E. Psarras, Multi-criteria decision aid for the formulation of sustainable technological energy priorities using linguistic variables. European Journal of Operational Research, 182(2), 844-855 (2007).
12. ELhassouny and F.Smarandache, Neutrosophic modifications of Simplified TOPSIS for Imperfect Information (nS-TOPSIS). Neutrosophic Sets and Systems, 100 (2019).
13. F. Smarandache, Extension of Soft set to Hypersoft Set, and then to Plithogenic Hypersoft Set. Neutrosophic set and Systems, 22, 68-70 (2018).
14. F. Smarandache, Plithogeny, Plithogenic Set, Logic, Probability, and Statistics. arXiv preprint arXiv:1808.03948 (2018).
15. F. Smarandache, A Unifying Field in Logic Neutrosophy, Neutrosophic Probability Set and Logic. rehoboth American Research Press (1999).
16. F. Smarandache, Neutrosophy, A New Branch of Philosophy, Multiple Valued Logic / An International Journal , USA,8(3), 297-384 (2002).
17. F. Smarandache, On Multi-Criteria Decision Making problem via Bipolar Single-Valued Neutrosophic Settings. Neutrosophic Sets and Systems, 25 (2019).
18. P. Chi and P. Liu, An extended TOPSIS method for the multiple attribute decision making problems based on interval neutrosophic set. Neutrosophic Sets and Systems, 1(1), 63-70 (2013).
19. A. Sanayei, S. F. Mousavi and A. Yazdankhah, Group decision making process for supplier selection with VIKOR under fuzzy environment. Expert Systems with Applications, 37(1), 24-30 (2010).
20. D. Molodtsov, Soft set theory-First results, Computers and mathematics with applications. 37, 19- 31 (1999).
21. N. A. Nabeeh, F. Smarandache, A. M. Basset, H. A. El-Ghareeb and A. Aboelfetouh, An Integrated Neutrosophic-TOPSIS Approach and Its Application to Personnel Selection: A New Trend in Brain Processing and Analysis. IEEE Access, 7, 29734-29744 (2019).
22. A. Ryjov, Fuzzy linguistic scales: definition, properties and applications. In Soft computing in measurement and information acquisition (pp. 23-38 Springer, Berlin, Heidelberg 2003).
23. D. Pie and D. Miao. "From soft set to informations systems," In: Proceedings of Granular computing, IEEE, 2, 617-621 (2005).
24. L. A. Zadeh, Fuzzy set, Inform and Control, 8, 338-353 (1965).
25. D. Nagarajan, M. Lathamaheswari, S. Broumi and J. Kavikumar, A new perspective ontraffic control management using triangular interval type-2 fuzzy sets and interval neutrosophic sets. Operations Research perspectives, Article in Press. https://doi.org/10.1016/j.orp.2019.100099
26. N.Sellapan, Nagarajan, D. and K. Palanikumar, Evaluation of risk priority number (RPN) in design failure modes and effects analysis (DFMEA) using factor analysis. International Journal of Applied Engineering Research, 10(14), 34194-34198 (2015).
27. D.Nagarajan, M. Lathamaheswari, R. Sujatha and J. Kavikumar, Edge Detection onDICOM Image using Triangular Norms in Type-2 Fuzzy. International Journal of Advanced Computer Science and Applications, 9(11), 462-475 (2018).
28. M. Lathamaheswari, D. Nagarajan, A. Udayakumar andJ. Kavikumar, Review on Type-2 Fuzzy in Biomedicine. Indian Journal of Public Health Research and Development, 9(12), 322-326 (2018).
29. D.Nagarajan, M. Lathamaheswari, J. Kavikumar and Hamzha, A Type-2 Fuzzy in Image Extraction for DICOM Image. International Journal of Advanced Computer Science and Applications, 9(12), 352-362 (2018).

30. M. Lathamaheswari, D. Nagarajan, J. Kavikumar and C. Phang, A Review on Type- 2 Fuzzy Controller on Control System. Journal of Advanced Research in Dynamical and Control Systems, 10(11), 430-435 (2018).
31. D.Nagarajan, M. Lathamaheswari, S. Broumiand J. Kavikumar, Blockchain Single andInterval Valued Neutrosophic Graphs. Neutrosophic Sets and Systems, 24, 23-35 (2019).
32. D.Nagarajan, M. Lathamaheswari, S. Broumiand J. Kavikumar, Dombi Interval Valued Neutrosophic Graph and its Role in Traffic Control Management. Neutrosophic Sets and Systems, 24, 114-133 (2019).